



Angelini, G. D., Ramsingh, R., Rahaman-Ganga, N., Rampersad, R., Rampersad, A., Rampersad, K., & Teodori, G. (2020). Developing a cardiac surgery unit in the Caribbean: A reflection. *Journal of Cardiac Surgery*. <https://doi.org/10.1111/jocs.14965>

Publisher's PDF, also known as Version of record

License (if available):
CC BY

Link to published version (if available):
[10.1111/jocs.14965](https://doi.org/10.1111/jocs.14965)

[Link to publication record in Explore Bristol Research](#)
PDF-document

This is the final published version of the article (version of record). It first appeared online via Wiley at <https://onlinelibrary.wiley.com/doi/10.1111/jocs.14965>. Please refer to any applicable terms of use of the publisher.

University of Bristol - Explore Bristol Research

General rights

This document is made available in accordance with publisher policies. Please cite only the published version using the reference above. Full terms of use are available:
<http://www.bristol.ac.uk/red/research-policy/pure/user-guides/ebr-terms/>

Developing a cardiac surgery unit in the Caribbean: A reflection

Gianni D. Angelini FRCS¹  | Richard A. E. Ramsingh MBBS² |
Natasha C. Rahaman FRCS² | Risshi D. Rampersad FACC² | Anand Rampersad FRCS² |
Kamal A. Rampersad MD² | Giovanni Teodori MD²

¹Bristol Heart Institute, University of Bristol, Bristol, UK

²Department of Cardiac Surgery and Cardiology, Caribbean Heart Care Medcorp, St. Clair Medical Centre, Port of Spain, Trinidad and Tobago

Correspondence

Gianni D. Angelini, FRCS, Bristol Heart Institute, Bristol Royal Infirmary, University of Bristol, Bristol BS2 8HW, UK.
Email: g.d.angelini@bristol.ac.uk

Abstract

Background and Aim: Access to specialized cardiac surgery is a problem in emerging countries. Here, we reflect on the approach we used to establish a cardiac surgery unit in Trinidad and Tobago.

Methods: The program started in 1993 with monthly visits by a team from Bristol Heart Institute. A group of local doctors, nurses, and perfusionists were identified for training, and a senior nurse moved to the island to start a teaching program. The visiting support was gradually reduced, and the local team gained independence in managing the service in 2006.

Results: The initial low volume surgery increased to around 380 cases a year with the implementation of comprehensive service in 2006. Most patients required coronary artery bypass graft (CABG). In-hospital mortality declined from 5% in the nascent years to below 2% thereafter. In the last 5 years (2015-2019), 1764 patients underwent surgery (mean age 59.6 ± 10.8 years, 66% male). The majority were East-Indian-Caribbean (79.1%) or Afro-Caribbean (16.7%), half had diabetes, and two-thirds hypertension (EuroScore II 1.8 ± 1.9). The majority (1363 patients) underwent CABG (99.5% off-pump; conversion to on-pump 1.5%). The mean number of grafts was 2.5 ± 0.7 with 98.5% and 23.1% receiving one and two or more arterial grafts, respectively. In-hospital mortality was 1.1%, re-exploration for bleeding 2%, stroke 0.1%, mediastinitis 0.2%. The length of the postoperative hospital stay was 5.8 ± 2 days.

Conclusion: Frequent outside visits complemented by training in an overseas center, and transfer of knowledge proved to be an effective strategy to develop a cardiac surgery unit in an emerging country with results comparable to accepted international standards.

KEYWORDS

cardiac surgery, emerging country, English-speaking Caribbean, global health, Trinidad and Tobago

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.

© 2020 The Authors. *Journal of Cardiac Surgery* published by Wiley Periodicals LLC

1 | INTRODUCTION

The English-speaking/Commonwealth Caribbean is a multiethnic society with a population of 6.2M people. Trinidad and Tobago is a dual-island republic near Venezuela with a population of 1.39M people. The ethnic makeup is dominated by two groups, roughly equal in size: Afro-Caribbean, descended from enslaved Africans brought in to work on sugar plantations beginning in the late 18th century, and Indo-Trinidadians, or East Indians, whose ancestors were primarily indentured laborers who immigrated from the Indian subcontinent as plantation workers after the abolition of slavery in the mid-19th century. People of mixed ethnicity, migrants from Spain and other European countries, Africa, East, and Southeast Asia, and the Middle East constitute a slightly smaller group of the islands' population.¹ The incidence of cardiovascular diseases among the different races is high at 32.6%, and approximately 20% are diabetic, 21% hypertensive, and 36.9% overweight.² A national health system program relies on a network of public clinics and hospitals where treatment is free or low-cost. Concerns about the quality of the care they offer have led to a proliferation of private, fee-paying hospitals and clinics. In the early 1980s, a state-of-the-art hospital, the Eric Williams Medical Science Complex (EWMSC) was opened with the aim of providing specialized services. However, despite this development, a patient requiring heart surgery had to travel to the United States or the United Kingdom.

In November 1993, a complete visiting team from the Bristol Heart Institute (BHI) performed the first open-heart procedure at the EWMSC, and following an agreement between local professionals and the BHI, a plan was implemented to develop a unit capable of dealing with the need of the population of Trinidad and Tobago and the surrounding Caribbean islands.³ From its inception, the aim was to support the unit with frequent visits from an overseas team and at the same time to train the local personnel. The final goal was a unit run independently, by the local professionals capable of delivering a service of international standards. Here we reflect on our experience and offer some insight which we hope will be of benefit to the surgical community and emerging countries wishing to develop a cardiac surgery program and confronted by a similar set of challenges.

2 | MATERIALS AND METHODS

2.1 | Local infrastructure, personnel, and finance

An exploratory visit was made in 1992 (GDA) at the request of local professionals interested in developing a private cardiac surgery unit. Previous attempts had been made by the government, but the project was considered too ambitious and abandoned. A visit to the EWMSC showed excellent theater, intensive care unit (ICU), and ward facilities that were fully equipped but still to be commissioned. The cardiology service was just in the process of starting to perform coronary angiography and related diagnostic procedures. Except for an anesthetist who had spent a few months at the Hammersmith

Hospital in London there was no cardiac surgery expertise whatsoever on the island. A private company was formed, Caribbean Heart Care (CHC), to finance the project. A local management team lead by a medically qualified doctor (KAR) secured rental of the necessary facility from the government at the EWMSC and plans were developed for the start of the surgery the following year by a complete overseas visiting team from the BHI.

2.2 | Overseas visiting team and training

The overseas team provided regular monthly visits for the duration of a week during which on average five to eight private operations were performed. The surgical team was initially made up of two surgeons, an anesthetist, a perfusionist, a scrub nurse, two intensive care nurses, and two ward nurses. One of the main aims of the projects was to progressively reduce the number of visiting team members and allow the local personnel to gain total independence. Two local anesthetists, a thoracic and a vascular surgeon, and a group of nurses (theater, ICU, and ward) were therefore identified for advanced training. The anesthetists started to manage the cases supervised by the visiting anesthetist. The local surgeons soon acquired the necessary skill to open and close the chest, harvest conduits, and establish cardiopulmonary bypass. However, because of the limited number of procedures performed, it was not possible to implement any appropriate local surgical training. Therefore, two young surgical trainees and a perfusionist were identified and offered a resident training position at the BHI. A senior nurse at a time on a rotational basis from the BHI moved to Trinidad with the aim to establish a teaching program for the intensive care and ward nurses.

Within 4 years from the start of the programme, the visiting team was composed only of the leading operating surgeon and perfusionist. In 2000, the perfusionist training at the BHI ended and he returned to Trinidad, and for the next 6 years, the only overseas professional was the main operating surgeon. The surgery was performed on a 1 to 2 weeks per month basis, depending on the number of cases. Dealing with an emergency case was not possible when the visiting surgeon was not in the country. The volume of surgery increased in 2003 when the government recognized the importance of the service. An agreement was reached between the company, CHC, and the government for a charitable joint venture and share the costs for up to 20 additional cases per month. At this time, the surgery was conducted on two different sites St Clair Medical Centre, a private institution for private patients, and at the EWMSC for the government programme. Of the two surgical trainees, on completion of their 6 years training at the BHI, one decided to stay in the United Kingdom whereas the other (NCR) returned home in 2006, together with another surgeon from the BHI who wished to spend a 2 years sabbatical in Trinidad. From this point in time, the local team managed to run an independent and comprehensive service including emergency surgery with a significant increase in the number of procedures per year. In 2008, a senior surgeon from Italy (GT) permanently joined the team. The team was now made of three surgeons (two consultant

equivalents and a senior resident), four anesthetists, three intensivists, one perfusionist, a group of specialized nurses, and supported by two cardiologists.

2.3 | Evaluation of results

The record on the volume of cases performed over the years (November 1993 to December 2019) is presented together with the type of surgery distribution and mortality figures. A detailed report of the last 5 years of results (2015–2019) is also presented. The choice of presenting this five-year period was made to have a snapshot of the most recent results from a well-established team that had worked together for many years. The study was performed as part of an approved audit, according to the specifications of the Declaration of Helsinki. The hospital's committee waived the need for individual consent. The 2015–2019 data were retrospectively reviewed from prospectively entered data. The results for 2020 have been reported separately as the experience of the unit in response to the COVID-19 crisis.⁴

3 | RESULTS

The annual volume of combined cases performed at the EWMSC and later at St Clair Medical Centre, the private hospital, improve steadily over the years. The government contract award in 2003 (up to 20 additional cases a month) significantly increased the workload (Figure 1). This combined with the establishment in 2006 of a comprehensive service managed entirely by the local team, resulted in a further increase in volume to around 360 to 380 cases a year. Coronary artery bypass graft (CABG) remains the main surgical procedure performed, followed by mitral and aortic surgery. A small proportion of miscellaneous cases included emergency type A acute aortic dissection, endocarditis, and correction of grown-up congenital heart defects (Figure 2). The overall mortality per periods is presented in Figure 3.

3.1 | Last 5 years (2015–2019) results

During the study period, 1764 patients underwent surgery, mean age 59.6 ± 10.8 years, of which 66% were male. The majority were East-Indian-Caribbean (79.1%) or Afro-Caribbean (16.7%), with the rest Caucasian, Chinese, and mixed race. More than half of the patients had diabetes (12.8% insulin-dependent), two-thirds were hypertensive and 8.7% had renal dysfunction. The mean EuroScore II (%) was 1.8 ± 1.9 . Most patients, 1363 underwent CABG, followed by mitral valve surgery (144 pts) with the majority being replacement (rheumatic disease) with about 20% repair. Sixty-four patients underwent AVR and 33, AVR plus CABG (Table 1). AVR or MVR with the combined procedure and miscellaneous cases are reported in Table S1.

Overall, in-hospital mortality in the series was 1.1% (20 pts), stroke 0.1% (2 pts), and mediastinitis requiring sternal revision 0.2% (3 pts). The use of IABP was 0.3% (5 pts) and the re-exploration for bleeding 2% (33 pts). Length of postoperative hospital stay was 5.8 ± 2 days (Table 2).

Of the 1356 patients undergoing CABG, 99.5% were performed off-pump with 20 patients requiring conversion to on-pump (1.5%). The mean number of grafts was 2.5 ± 0.7 with 98.5% and 23.1% receiving one and two or more arterial grafts, respectively. In-hospital mortality was 0.8% (11 pts), use of IABP 0.2% (3 pts), re-exploration for bleeding 1.2% (17 pts), stroke 0.1% (1 pts), mediastinitis 0.2% (3 pts) and length of postoperative hospital stay 5.5 ± 1.5 days (Table 3).

4 | DISCUSSION

In emerging countries with no specialized cardiac surgery units, most patients have no choice but to live with their cardiovascular condition unless they can afford to travel abroad for high-cost treatments. In an American Association for Thoracic Surgery presidential address in 2001, James Cox called for action to reduce worldwide inequalities in cardiac surgical care.⁵ However, finding the best way to establish a

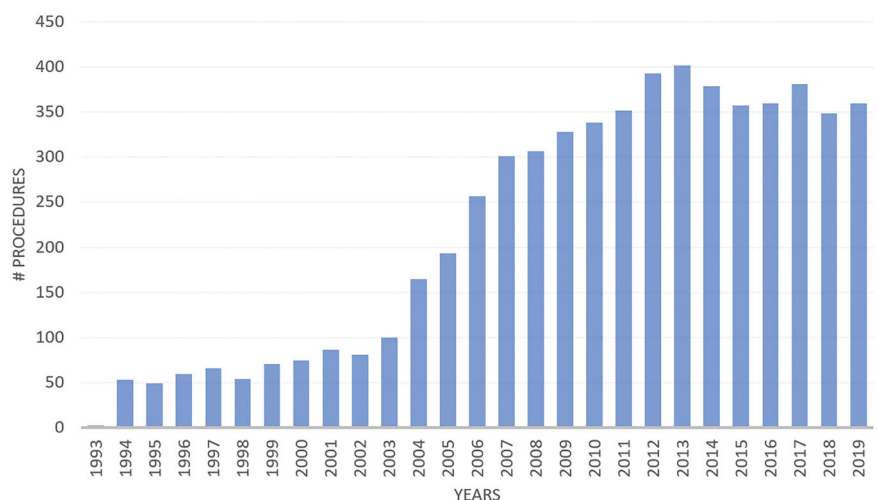


FIGURE 1 Total number of procedures per year

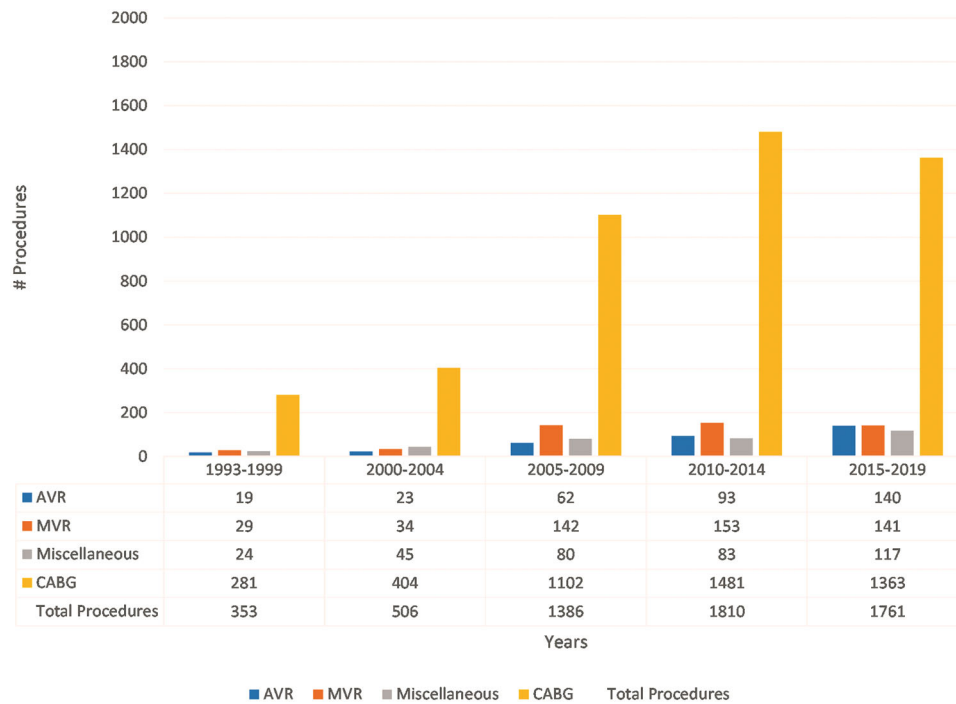


FIGURE 2 Number of coronary artery bypass graft (CABG), aortic valve replacement (AVR), mitral valve replacement (MVR), miscellaneous, and total procedures per 5-year period

sustainable specialized local cardiac surgery facility in an emerging country remains a matter of debate.⁶⁻⁹ The use of visiting teams sent in “missions” has been one of the most common practices. Teams of cardiac surgeons, cardiologists, nurses volunteer their time for 1 to 2 weeks to treat adult or pediatric patients. Although highly skilled, they performed a limited number of procedures, often facing challenging conditions like poor facilities and lack of local specialized personnel. This approach has been questioned by the European Association of Cardiothoracic Surgery and its International Committee, which does not believe that the best solution is achieved by sending teams to the developing world.⁷ Vervoort et al point out,

that there are 77 non-profit, nongovernmental organizations that have attempted to provide some cardiac surgery care in low- to low-middle income groups. They suggested a unified approach that includes these organizations, perhaps with an overarching, more global administrative structure, that could allocate needed resources to specific areas.⁶ However, what seems to be missing, as suggested by Ferraris and Pezzella,⁷ is an organized approach that understands the needs and is capable of allocating assets to the under-resourced low-income countries. The World Heart Foundation, which was founded in 1999 to help develop cardiac surgery in the emerging world, suggested teaching via the Internet, complemented with local visits.⁸

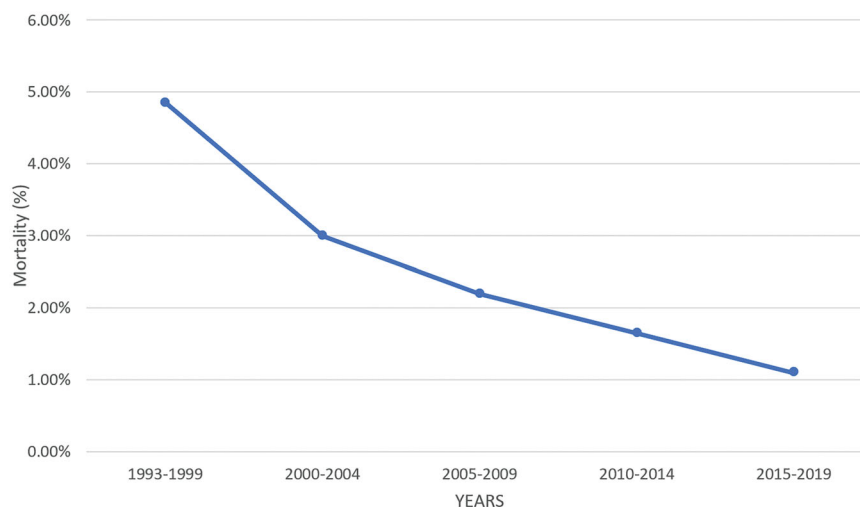


FIGURE 3 Overall mortality per 5-year period

TABLE 1 Patient Characteristics by operation (2015-2019)

	N (%) (N = 1764)	CABG (N = 1363)	AVR (N = 64)	AVR + CABG (N = 33)	AVR + others (N = 43)		Asc.Ao.A (N = 13)	
Age, y	59.6 ± 10.8	60.5 ± 9.4	58.9 ± 13.9	67.0 ± 7.7	55.2 ± 13.5		57.5 ± 13.3	
Sex								
Male	1163 (65.9)	942 (69.1)	32 (50.0)	21 (63.6)	25 (58.1)		8 (61.5)	
Female	601 (34.1)	421 (30.9)	32 (50.0)	12 (36.4)	18 (41.9)		5 (38.5)	
Ethnicity								
East-Indian Caribb	1396 (79.1)	1146 (84.1)	37 (57.8)	27 (81.8)	20 (46.5)		4 (30.8)	
Afro-Caribb	294 (16.7)	167 (12.3)	21 (32.8)	6 (18.2)	18 (41.9)		8 (61.5)	
Caucasian	30 (1.7)	24 (1.8)	2 (3.1)	0 (0)	2 (4.7)		0 (0)	
Chinese	20 (1.1)	13 (1.0)	2 (3.1)	0 (0)	2 (4.7)		0 (0)	
Mixed	24 (1.3)	13 (1.0)	2 (3.1)	0 (0)	1 (2.3)		1 (7.7)	
Diabetes	1010 (57.2)	884 (64.9)	20 (31.3)	24 (72.8)	8 (18.7)		1 (7.7)	
IDDM	226 (12.8)	208 (15.3)	4 (6.3)	2 (6.1)	2 (4.7)		0 (0)	
Hypertension	1321 (74.9)	1126 (82.1)	28 (43.8)	24 (72.7)	19 (44.2)		9 (69.2)	
Creatinine >1.5	153 (8.7)	118 (8.7)	5 (7.8)	6 (18.2)	6 (15.8)		0 (0)	
Preoperative IABP	15 (0.9)	9 (0.7)	0 (0)	1 (3.0)	0 (0)		0 (0)	
LVEF (%)	53.7 ± 29.6	54.0 ± 30.9	60.6 ± 9.7	55.0 ± 13.7	38.5 ± 46.2		51.0 ± 8.7	
EuroScore II (%)	1.8 ± 1.9	1.5 ± 1.0	1.9 ± 1.7	2.4 ± 1.1	3.3 ± 2.9		1.7 ± 0.5	
	MVR (N = 91)	MV repair (N = 27)	MVR + others (N = 26)	TAD (N = 16)	VSD (N = 7)	ASD (N = 30)	Misc (N = 12)	Redo (N = 39)
Age, y	54.9 ± 14.7	57.4 ± 11.0	53.8 ± 13.3	53.2 ± 12.4	64.0 ± 9.7	43.6 ± 15.7	52.6 ± 16.3	58.6 ± 13.0
Sex								
Male	51 (56.0)	23 (85.2)	13 (48.3)	11 (68.8)	5 (71.4)	4 (13.3)	3 (25.0)	25 (64.1)
Female	40 (44.0)	4 (14.8)	13 (51.7)	5 (31.3)	2 (28.6)	26 (86.7)	9 (75.0)	14 (35.9)
Ethnicity								
East-Indian Caribb	57 (62.6)	21 (77.8)	13 (50.0)	7 (43.8)	6 (85.7)	23 (76.7)	5 (41.7)	30 (76.9)
Afro-Caribb	30 (33.0)	5 (18.5)	12 (46.2)	7 (43.8)	1 (14.3)	7 (23.3)	6 (50)	6 (15.4)
Caucasian	1 (1.1)	0 (0)	1 (3.8)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Chinese	1 (1.1)	0 (0)	0 (0)	1 (6.3)	0 (0)	0 (0)	0 (0)	1 (2.6)
Mixed	2 (2.2)	1 (3.7)	0 (0)	1 (6.4)	0 (0)	0 (0)	1 (8.3)	2 (5.1)
Diabetes	23 (25.3)	13 (48.1)	6 (23.1)	1 (6.3)	4 (57.1)	4 (13.3)	0 (0)	21 (53.9)
IDDM	2 (2.2)	3 (11.1)	1 (3.8)	0 (0)	0 (0)	0 (0)	0 (0)	4 (10.3)
Hypertension	38 (41.8)	17 (63)	12 (46.2)	10 (62.5)	5 (71.4)	9 (30.0)	3 (25.0)	21 (53.8)
Creatinine >1.5	5 (5.5)	2 (7.4)	3 (11.5)	3 (18.8)	1 (14.3)	1 (3.3)	1 (8.3)	2 (5.1)
Preoperative IABP	0 (0)	2 (7.4)	0 (0)	0 (0)	3 (42.9)	0 (0)	0 (0)	0 (0)
LVEF (%)	56.6 ± 19.8	43.1 ± 15.3	44.8 ± 43.2	54.4 ± 10.0	44.9 ± 15.1	61.1 ± 8.0	57.3 ± 9.0	49.8 ± 26.9
EuroScore II (%)	1.7 ± 1.2	5.6 ± 4.4	2.8 ± 2.8	2.9 ± 0.4	1.1 ± 0.8	1.0 ± 0.4	1.3 ± 0.4	7.3 ± 6.7

Note: Values are means ± SD, N (%).

Abbreviations: Asc Ao. A, ascending aortic aneurysm; ASD, atrial septal defect; AVR, aortic valve replacement; Caribb, Caribbean; CABG, coronary artery bypass graft; IABP, intra-aortic balloon pump; IDDM, insulin-dependent diabetes mellitus; LVEF, left ventricular ejection fraction; Misc, miscellaneous; MV, mitral valve; MVR, mitral valve replacement; TAD, Type A aortic dissection; VSD, ventricular septal defect.

An alternative option would be to train a complete team from a developing country in a foreign specialized unit. However, this is often impractical, complex, and expensive. The ideal solution would be to build a local cardiac surgery unit that will ultimately deliver continuous treatment for patients. However, each developing nation

has its unique environment, and starting a new program that requires extensive preparation and financial commitment to a long-term project, can be a problem.

In the early '90s, when we planned to develop a cardiac unit in Trinidad and Tobago, we formulated a medium to long term strategy

TABLE 2 Postoperative complications by operation (2015-2019)

	N (%) (N = 1764)	CABG (N = 1363)	AVR (N = 64)	AVR + CABG (N = 33)	AVR + others (N = 43)	Asc.Ao.A (N = 13)
Complications						
IABP (post-op)	5 (0.3)	3 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)
Re-exploration for bleeding	33 (2)	17 (1.2)	2 (3.1)	1 (3.0)	5 (11.6)	2 (15.4)
Stroke	2 (0.1)	1 (0.1)	0 (0)	0 (0)	1 (2.6)	0 (0)
Mediastinitis	3 (0.2)	3 (0.2)	0 (0)	0 (0)	0 (0)	0 (0)
Pacemaker or ICD	8 (0.5)	0 (0.0)	0 (0)	0 (0)	4 (9.3)	0 (0)
Mortality	20 (1.1)	11 (0.8)	0 (0)	0 (0)	2 (4.7)	0 (0)
Length of hospital stay (days)	5.8 ± 2.0	5.5 ± 1.5	6.4 ± 3.0	6.8 ± 2.6	8.1 ± 4.4	8.3 ± 5.2

	MVR (N = 91)	MV repair (N = 27)	MVR + others (N = 26)	TAD (N = 16)	VSD (N = 7)	ASD (N = 30)	Misc (N = 12)	Redo (N = 39)
Complications								
IABP (post-op)	0 (0)	1 (3.7)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.6)
Re-exploration for bleeding	0 (0)	3 (11.1)	0 (0)	1 (6.3)	0 (0)	0 (0)	0 (0)	2 (5.1)
Stroke	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mediastinitis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Pacemaker or ICD	3 (4.6)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1 (2.6)
Mortality	1 (1.1)	2 (7.4)	0 (0)	1 (6.3)	1 (14.3)	0 (0)	0 (0)	2 (5.1)
Length of hospital stay (days)	6.4 ± 2.5	6.8 ± 2.9	6.3 ± 1.8	7.9 ± 2.3	9.0 ± 4.9	5.7 ± 2.0	5.8 ± 0.8	6.5 ± 1.8

Note: Values are N (%).

Abbreviations: Asc Ao. A, ascending aortic aneurysm; ASD, atrial septal defect; AVR, aortic valve replacement; CABG, coronary artery bypass graft; IABP, intra-aortic balloon pump; ICD, implantable cardioverter-defibrillator; Misc, miscellaneous; MV, mitral valve; MVR, mitral valve replacement; TAD, Type A aortic dissection; VSD, ventricular septal defect.

based primarily on transmitting the knowledge within the country itself by making regular and frequent visits to a selected hospital. The prerequisite was a suitable facility for performing surgery with the aid of local specialists. This was also going to be complemented with the selection of personnel, who could be either trained locally or in the specialized overseas centre (BHI). A senior nurse from the BHI,

sent on a rotational basis would also be seconded for 4 years to start a local teaching program.

A company, CHC, was formed to finance the venture, and a leadership team was established consisting of a general manager to supervise the project, a local cardiologist to coordinate patient referrals, and a visiting cardiac surgeon to oversee the program's progress. We were fortunate that on the island there was a newly built state of the art hospital with excellent facilities including ICU and operating theaters still requiring commissioning. A contract was made to rent facilities from the government and commission these to start the cardiac surgery program. At the time, the service was entirely based on paying patients. The first 10 years were characterized by a low volume of surgery performed on a weekly visit basis with the overseas teams progressively reducing visit frequency. The aim was to gradually increase the responsibility of the local professionals. Within 6 years we had trained the local anesthetists, perfusionists, and nurses, but not a surgeon acting at consultant level. The low number of procedures performed, allowed only limited local surgical training, hence the reason to select two young surgeons for training at the BHI. The presence of a visiting surgeon was required until the case volume increased and one of the trainees returned to the island. Ultimately, it took about 11 years for the full team to run independently a comprehensive service, including

TABLE 3 CABG operative details and complications (2015-2019)

	(N = 1363)
Off-pump CABG	1356 (99.5)
On-pump CABG	7 (0.5)
Converted on-pump CABG	20 (1.5)
Mean grafts/patient	2.5 ± 0.7
≥1 Arterial grafts	1343 (98.5)
≥2 Arterial grafts	315 (23.1)
No. of distal anastomoses	
1	87 (6.4)
2	534 (39.2)
3	674 (49.4)
≥4	68 (5.0)

Note: Values are means ± SD, N (%).

Abbreviation: CABG, coronary artery bypass graft.

emergencies. In retrospect, we should have started the training of the lead surgeon from the beginning of the program. However, because of the lack of government support it was not clear how sustainable the program would be in the long term. With the charitable agreement between the government and the company CHC, the volume of surgery increased to around 360 to 380 cases a year.

In the first 10 years of the program, despite the low volume surgery, good results were achieved with a progressive reduction in overall mortality from around 5% to below 2% in recent years. This was most likely the result of training and accumulating experience and expertise as well as the increase in cases. The last 5 years' results show a very low incidence of postoperative complications in comparison to established norms. Of interest is the younger age of the patients with significant risk factors, half the patients were diabetic, two-thirds hypertensive, and not surprisingly with an associated underlying degree of renal dysfunction. This explains why almost two-thirds of patients in the series underwent CABG. This was performed off-pump in almost all cases with very little requirement for conversion to on pump. This reflected the off-pump practice at the BHI which influenced training, but also the desire to minimize postoperative bleeding associated with the technique.¹⁰ This was in part dictated by the limited access to blood products and particularly platelets and fresh frozen plasma on the island and a practical decision to reduce costs. This policy seems to be justified by the low 1.2% rate of reopening for bleeding. The incidence of mediastinitis was also very low at 0.2% considering the high incidence of diabetes in our patient population. The data we present, although not risk-adjusted, compares favorably to those of the training centre (BHI).^{10,11} These results from a low-mid volume unit seem to be a little at odds with the consensus in the literature that a certain minimal volume of surgery is needed to be performed, by individual surgeons or institutions, to obtain good quality results.¹²⁻¹⁴ A limitation of this report is the absence of long-term follow-up data. However, it is challenging to follow patients coming from different islands, and it is the unit's practice to send patients back to the referring cardiologist.

5 | CONCLUSION

Frequent regular outside visits, identification of a core group to be trained locally, complemented with training in a designated partner overseas center and transfer of knowledge, proved to be the right strategy to develop a cardiac surgery unit in an emerging country with results comparable to accepted international standards. The success of the program was the result of appropriate long-term planning and execution and was made possible by an enthusiastic local management team and a dedicated and motivated medical, nursing, and perfusion group of professionals.

ACKNOWLEDGMENTS

We wish to thank all the overseas personnel who helped to establish the cardiac unit and all the members of the local team, who made this a reality. The British Heart Foundation and the NIHR Bristol Biomedical Research Centre supported this study.

CONFLICT OF INTERESTS

The authors declare that there are no conflict of interests.

ORCID

Gianni D. Angelini  <http://orcid.org/0000-0002-1753-3730>

REFERENCES

1. Robinson ANR. *The Mechanics of Independence: Patterns of Political and Economic Transformation in Trinidad and Tobago*. Port of Spain Trinidad and Tobago: University of the West Indies Press; 2001.
2. Health in the Americas. Country report—Trinidad and Tobago. https://www.paho.org/salud-en-las-americas-2017/?page_id=159. Accessed 5 August 2020.
3. Burgos-Irazabal J, Rampersad RD, Gomes WJ, Rampersad KA, Angelini GD. Cardiac surgery in a multi-ethnic low volume service: the Caribbean Heart Care Experience. *Braz J Cardiovasc Surg*. 2005;20(3):332-335. <https://doi.org/10.1590/S0102-76382005000300016>
4. Ramsingh RAE, Duval JL, Rahaman NC, Rampersad RD, Angelini GD, Teodori G. Adult cardiac surgery in Trinidad and Tobago during the COVID-19 pandemic: lessons from a developing country. *J Cardiac Surg* (in press).
5. Cox JL. Presidential address: changing boundaries. *J Thorac Cardiovasc Surg*. 2001;122(3):413-418. <https://doi.org/10.1067/mtc.2001.118489>
6. Vervoort D, Meuris B, Meyns B, Verbrugghe P. Global cardiac surgery: access to cardiac surgical care around the world. *J Thorac Cardiovasc Surg*. 2020;159(3):987-996.e6. <https://doi.org/10.1016/j.jtcvs.2019.04.039>
7. Ferraris VA, Pezzella AT. Commentary: worldwide disparities in cardiac surgical care: thinking globally not locally to solve problems of limited resources and access to specialized care. *J Thorac Cardiovasc Surg*. 2020;159(3):997-999. <https://doi.org/10.1016/j.jtcvs.2019.04.070>
8. Velebit V, Montessuit M, Bednarkiewicz M, Khatchatourian G, Mueller X, Neidhart P. The development of cardiac surgery in an emerging country. *Tex Heart Inst J*. 2008;35(3):301-306.
9. Ghosh P. Setting up an open heart surgical program in a developing country. *Asian Cardiovasc Thorac Ann*. 2005;13(4):299-301. <https://doi.org/10.1177/021849230501300401>
10. Angelini GD, Taylor FC, Reeves BC, Ascione R. Early and midterm outcome after off-pump and on-pump surgery in Beating Heart Against Cardioplegic Arrest Studies (BHACAS 1 and 2): a pooled analysis of two randomised controlled trials. *The Lancet*. 2002; 359(9313):1194-1199. [https://doi.org/10.1016/S0140-6736\(02\)08216-8](https://doi.org/10.1016/S0140-6736(02)08216-8)
11. University Hospital Bristol NHS FT|Society for Cardiothoracic Surgery in Great Britain and Ireland. UK Cardiothoracic Units & Outcomes. Scts.org. <https://scts.org/hospital/bristol-heart-institute/?outcomes=cardiachttps://scts.org/wp-content/uploads/2019/09/BRI-Forest.jpeg>. Accessed 5 August 2020.
12. Hillis LD, Smith PK, Anderson JL, et al. ACCF/AHA Guideline for Coronary Artery Bypass Graft Surgery. A report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. Developed in collaboration

with the American Association for Thoracic Surgery, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons. *J Am Coll Cardiol*. 2011;58(24):e123-e210. <https://doi.org/10.1016/j.jacc.2011.08.009>

13. Dudley RA, Johansen KL, Brand R, Rennie DJ, Milstein A. Selective referral to high-volume hospitals: estimating potentially avoidable deaths. *J Am Med Assoc*. 2000;283(9):1159-1166. <https://doi.org/10.1001/jama.283.9.1159>
14. Gutacker N, Bloor K, Cookson R, et al. Hospital surgical volumes and mortality after coronary artery bypass grafting: using international comparisons to determine a safe threshold. *Health Serv Res*. 2017;52(2):863-878. <https://doi.org/10.1111/1475-6773.12508>

SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Angelini GD, Ramsingh RA, Rahaman NC, et al. Developing a cardiac surgery unit in the Caribbean: A reflection. *J Card Surg*. 2020;1-8. <https://doi.org/10.1111/jocs.14965>